NORTHERN RESEARCH REPORTS

AEROBIOLOGY

Aerobiological Investigations in the Arctic and Subarctic

In view of the considerable development of the subject in civilized regions, and of its possible economic as well as academic significance, it is surprising how little work has been done in the North on the presence and identity of botanical and other 'particles' in the atmosphere. To be sure, it has long been known that fungal spores and other disseminules may be present in the air in boreal regions north of the limits of extensive cultivation—as for example over Norway House, Manitoba—but so far as the Arctic and Subarctic are concerned the undersigned know of only two attempts at aerobiological investigations prior to 1947. These were by one of us (N.P.) in Lapland and Spitsbergen in 1933, and by Lindbergh over Greenland etc. in the same year. The former work was abortive in that the "observations" were deemed insufficiently reliable for publication although they gave some suggestion of the presence of rather plentiful viable disseminules in the air at low altitudes; the latter work appeared to confirm these suggestions for higher altitudes but was unfortunately never described in any detail. It remained for one of us (N.P.), while flying with the Royal Canadian Air Force during August and September, 1947, on operations concerned primarily with ground survey work and locating the North Magnetic Pole, to expose from his aircraft nutrient Petri plates and vaselined microscopical slides especially prepared and packed under the direction of another of us (S.M.P.). Details of preparation, exposure, and packaging have already been published (*Nature*, vol. 160, pp. 876-7, 1947); a total of 51 plates and 52 slides were exposed, the former for two minutes each and the latter for five minutes each. Not a single contamination developed on any of the 7 unexposed plates that were brought back as controls, so that full confidence is felt in the apparatus and methods employed although these were quite simple.

Most of the 1947 exposures were made at or around an altitude of 5,000 feet and airspeed 100 knots (115 m.p.h.), well outside the fuselage of Norseman and Canso aircraft. Except for inevitable gaps due to liquid or ice precipitation or preoccupation with landing, etc., a nutrient plate and a sticky slide were exposed either every twenty or every thirty miles, approximately, throughout the flights concerned. The first of these flights was on August 12th, and extended in a northerly direction from a base-camp situated on an unnamed lake north-west of Great Bear Lake to Langton Bay on the Arctic Ocean coast, and thence to the mouth of the Horton River. The later exposures extended over about 1,500 miles from Somerset Island southwards to Edmonton, Alberta.

The vaselined slides have been sent to specialists to examine for the spores of pathogenic Fungi which do not culture. Already the Dominion Rust Research Laboratory, Winnipeg, have reported that on some of the slides exposed near the Arctic Ocean coast there are represented spores of three of the most important airborne pathogens of cereal crops of Canada, viz. Wheat Stem-rust (*Puccinia graminis tritici*), Wheat Leaf-rust (*P. rubigo-vera*=*P. triticina*), and Foot-rot of Barley and Rye (*Helminthosporium sativum*). This is the better part of 1000 miles north of the Peace River region, which is the nearest likely source of supply of any real extent, and would seem to extend remarkably the much-cited "at

least 200 miles" that spores of the first-named important parasite (which alone has caused an estimated loss in western Canada through injury to the Wheat crop of as much as $200,000,000 in a single year) are known to have been disseminated. Subsequently the slides will be sent to pollen specialists who will determine their pollen-grain holding, which curiously enough may be of significance in connexion with investigations of 'muskegs.' Later, other specialists may be involved in various fields.

We ourselves are dealing in the first instance with the considerable range of Fungi and Bacteria that are represented on the plates. And whereas we had expected few or no colonies to develop on incubation of the plates that had been exposed in the Far North, for instance in northerly winds over the ice-fields of M'Clintock Channel, we find that almost all on return bore numerous and various colonies of Fungi and Bacteria, indicating both these groups to be abundantly and diversely represented in the arctic atmosphere. As examples we may note that one plate exposed at 4,500 feet near the east coast of Somerset Island around latitude 72°40′N. and logitude 94°W. showed a total of 12 colonies of Fungi and 79 of Bacteria, while another exposed at 4,400 feet over the sea-ice of M'Clintock Channel showed 7 colonies of Fungi and 95 of Bacteria. On the other hand, a plate exposed only 10 minutes earlier than the first-mentioned, and in the same general region, showed only 3 fungal and 47 bacterial colonies. A more detailed report will follow in due course.

It is our earnest hope to be able to continue and extend these investigations in various ways, particularly in the near future through winter and summer flights to the North Pole and by comparison of the spore content of the arctic air at different altitudes from the ground upwards. Such observations, when correlated with the clear meteorological conceptions and particularly more detailed upper-air movement data that will be forthcoming shortly, should tell us much about the origin, trajectory, and fate of these disseminules.

McGill University, Montreal.

NICHOLAS POLUNIN,
S. M. PADY,
C. D. KELLY.

BOTANY

Mackenzie Valley

A. E. Porsild, Chief Botanist, of the National Museum of Canada, Ottawa, accompanied by Ralph Bryenton of the Pas, Man., in July travelled down the Mackenzie River by canoe, where he paid particular attention to tree species and to problems of plant succession following the last 25 year's of forest fires. His collection of plants made along the Mackenzie includes a number of rare and interesting species previously known to extend only to Slave Lake.

After reaching the Delta, he spent a month in the Mackenzie Reindeer Grazing Reserve where he reported on the progress made in the reindeer experiment since 1936. Travelling by plane he examined the spring, summer, fall and winter reindeer pasture throughout the reserve, from the East Bound to the Anderson River.

Leaving Aklavik on August 19, he travelled by air via Edmonton to Fairbanks, Alaska, where, on August 29-30, he accompanied a reconnaissance flight

across the northern part of the Arctic Archipelago to Ellesmere Island and back. He returned to Ottawa on September 3rd.

James and Hudson Bays

A second National Museum field party spent the summer making a botanical survey of the east coast of James and Hudson Bay. In the party were W. K. W. Baldwin and James Kucyniack of the National Museum, the ecologist I. Hustich and the bryologist R. Tuomikoski, both of the University of Helsinki, Finland, and both travelling on an Arctic Institute of North America Research grant. With the party travelled the geologist Dr. E. H. Kranck of the University of Neuchatel, Switzerland. The party left Ottawa in late June travelling from Moosonee by schooner and canoes; they returned to Ottawa early in September.

James Kucyniak assisted in the technical work of collecting vascular plants and cooperated with Dr. Tuomikoski in collecting mosses and made special collections of lichens. W. K. W. Baldwin made a general collection of vascular plants sufficient for six duplicate sets. Rare and critical species were collected from as many different habitats and stations as practical. Ecological notes were made at each station and were supplemented by many photographs showing topography and vegetation types. Observations were also made of forage cover with particular emphasis on requirements for caribou and domesticated reindeer.

The main work of Dr. Tuomikoski was to investigate the flora of Bryophytae. No professional bryologist had earlier visited the region. The moss flora was not particularly rich, but about 265 species were collected, including one which seems to have been unknown to science. The material collected and registered gives a clear picture of the difference between the more arctic moss flora on the islands and the moss flora on the mainland, as well as between that on the mainland around James Bay and on the more rocky terrain around Hudson Bay. The moss flora consists of about ninety percent of circumpolar arctic and subarctic species. Only a more careful microscopical investigation can show whether it is possible to distinguish between American and European races of the same species.

I. Hustich studied the forest conditions in the region. Notes were made on the maritime tree limits on the coast and islands of James Bay and southern Hudson Bay, where the dominance of white spruce was noticed. Several weeks were spent at Great Whale River making forest type analyses and increment borings.

Ungava

Dr. Jacques Rousseau, Director of the Montreal Botanical Garden, spent the 1947 summer field season in Ungava, following the George River from its source near Lake Mishikaman for about 350 miles to the sea. Dr. Rousseau made a large herbarium collection and also was able to make notes on geology, native peoples, and animal life.

Dr. Rousseau hopes to be able to continue his study of Northern Quebec in 1948 with a journey from Payne Bay to the eastern shore of Hudson Bay.

ZOOLOGY

Nueltin Lake Expedition

Dr. Francis Harper spent from May 31 to December 4, 1947, in the area about the northwestern extremity of Nueltin Lake in southwestern Keewatin. This lake lies near the centre of one of the largest regions of western Canada not hitherto investigated by professional biologists. Scarcely any definite or authentic information had been available concerning the fauna and flora within a radius of some 200 miles in most directions.

The principal objectives of the expedition were investigations of the local fauna, flora, geography, and physiography. The 250-mile trip each way between Churchill and Nueltin Lake was accomplished by air. Early arrival and late departure made possible observation of the greater part of the annual migrations of the birds and the Barren Ground Caribou.

The season's collections included more than 100 mammals, more than 100 birds, several Wood Frogs, some dozens of fishes (apparently representing every species known to the Nueltin region), and varying numbers of worms, mollusks, crustaceans, insects, arachnids, plankton, and diatoms. Special attention was paid to ectoparasites of mammals and birds, and to both external and internal parasites of fishes. About 800-1,000 sheets of plants were collected representing flowering plants, ferns and their allies, mosses, fungi, and lichens. The photographic material consists of 1,000 feet of 16-mm. motion pictures in color, 120 35-mm. photographs in color, and about 325 4 x 5 inch negatives in black and white.

A large fund of information on the distribution, ecology, economics, habits, and general life histories of the local vertebrates was assembled. Several sketch maps, will supplement the inadequate maps, hitherto available. Perhaps the most interesting physiographic feature noticed was an ancient beach terrace evident at several different points about Windy Bay, at an elevation approximately 100 feet above Nueltin Lake.

Farley M. Mowat of the University of Toronto, accompanied Dr. Harper during the first month of the expedition. In June he travelled by dog-team along Windy River remaining for a month on a faunal survey and collecting invertebrates fish, birds and mammals. During July he travelled by canoe to Brochet by the Kasmere River, returning early in August. Following some time spent on topographical sketching on Nueltin Lake he descended the Thlewiaza River to Hudson Bay by canoe, and reached Eskimo Point at the end of August.

Forest Fur Animal and Ecology and Management

Professor H. F. Quick left Colorado late in August 1947, to spend the winter at Fort Nelson, B.C., to study the fur animals of the surrounding area of about 50,000 square miles. He is particularly interested in the species and numbers of prey animals and has also undertaken small mammal population studies in two widely separated parts of the region. Another purpose of the expedition is to make a study of the food habits of the wolverine, fisher and lynx. The assistance of trappers in the vicinity has been secured.

Marine Biological Reconnaissance in Ungava Bay, 1947

At the request of the Department of Mines and Resources, the Fisheries Research Board of Canada undertook a preliminary survey of the marine resources

of Ungava Bay during the summer of 1947, with the ultimate purpose of improving the diet and standard of living of the Ungava Eskimos. Serious malnutrition had been found among these natives. The work was planned and carried out by Dr. Max Dunbar, of McGill University, who with Mr. Henry Hildebrand, also of McGill, spent three months in the field. The party flew to Fort Chimo by special R.C.A.F. aircraft, with some 3,000 lbs. of equipment, in June. The coastal waters of Ungava Bay were covered from Payne Bay in the North-west to Port Burwell in the North-east. A comprehensive collection of benthos, plankton and fish was brought home, and the hydrographic work included observations of temperature, salinity and oxygen at all depths. The expedition made a first-hand study of the native economy, and an estimate of the status of the seals of Ungava Bay. Littoral collections were also taken, and Mr. Hildebrand made a representative collection of the birds of the region for the National Museum of Canada. Among the results immediately available were the finding of hydrographic conditions mid-way between the arctic conditions of the Baffin Island coasts and the marked sub-arctic waters of west Greenland; high biological production; and definite possibilities in certain areas of native fisheries for Atlantic cod, shark, and perhaps Greenland halibut. It is intended to continue and extend the work in 1948.

The Ungava Bay Fisheries Expedition of 1947, led by Dr. Dunbar, established a most interesting precedent in international research in the north, in that the party included a native Greenland fisherman, Josias Vetterlain of Jakobshavn. The purpose in bringing a Greenlander over to Ungava Bay was twofold; first to introduce into the minds of a few Ungava natives the idea of the possibility of marine fisheries (here was a man who says it works well among the Greenlanders), and secondly to have a man who would demonstrate the practical details of the fishing methods used in Greenland.

Josias was obtained through the willing cooperation of the Greenland Administration in Copenhagen, and the equally willing aid of the U.S. Army Air Force was enlisted in flying him to Fort Chimo, and home again in September. Josias joined the expedition at George River, and during the exploration of the eastern water of Ungava Bay he fulfilled all expectations in demonstrating the Greenland methods. The language of communication was, in the main, Danish. The Ungava Eskimos found considerable difficulty in understanding the north Greenland dialect, and at first the differences in pronunciation of a few words which were mutually understood caused great hilarity. Josias very soon accustomed himself to the new surroundings, and got along very well with the crew. The lessons he taught will be remembered by those who came in contact with him, and it is hoped that the experiment can be repeated in 1948.

ENTOMOLOGY

Studies of Arctic and Subarctic Colias Butterflies

Dr. William Hovanitz carried out reconnaissance field work at points ranging from central Alberta to the Arctic coast at Coppermine during the 1947 field season. The period of adult flight of Arctic *Colias*, is restricted to a period of about two weeks at any one locality. Observation of the local weather was

necessary in order to time the trip to coincide with the period of flight. Numerous species were observed and comparisons were made between the Alpine Zones of the Rockies and the true Arctic at sea level. Considerable additional work is required to understand the nature of hybridization between species of *Colias*. *Colias boothi* appears to be a product of hybridization between *C.hecla* and *C.nastes*, but whether it is remains to be seen. The food plants, often the best diagnostic character for these species are unknown as yet.

MEDICINE

Queen's University Expedition to Southampton Island

The Queen's University Arctic Expendition which went to Southampton Island, North West Territories, in the summer of 1947 observed the morbidity of various diseases among the Eskimo, studied their nutritional habits and status, and carried out certain dietary experiments concerned with the tolerance of the Eskimo for pemmican, and the development of acidosis while on a high fat diet and during starvation. The party was made up of Dr. Malcolm Brown, Associate Professor of Medicine, Dr. R. G. Sinclair, Professor of Biochemistry, Dr. L. B. Cronk and Mr. George Clark, and was flown to its destination in planes of the Royal Canadian Air Force by way of Winnipeg and Churchill.

It was found possible to reach and examine medically eighty per cent. of the native population of Southampton Island. They were brought by boat to the clinic established by the Expedition at Coral Harbour where they were given a thorough medical examination and samples of blood and urine were collected. The results show that the chief causes of illness are respiratory tract infections and tuberculosis and these would also appear to be the chief causes of death. An interesting observation was the discovery that a third of those examined had livers which were considerably enlarged by ordinary standards. Specimens of liver obtained from two subjects showed that the enlargement was due to the presence of large amounts of fat, and further work is being done on this problem which is of considerable interest.

Evidence of serious nutritional deficiencies was widespread. Many of the children were underweight, some almost emaciated, and at all ages findings suggestive of riboflavin and ascorbic acid deficiencies were common. Determination of the blood ascorbic acid level confirmed the clinical conclusions with regard to ascorbic deficiency. Studies of excreta, which were carried out in association with Dr. E. E. Kuitunen of the University of Toronto, showed a high incidence of intestinal parasitic infection.

A small representative group of Eskimos was selected to determine average daily food intake, tolerance for pemmican, and the rate at which they develop acidosis during starvation. In contrast with Canadian and American soldiers the Eskimos could eat large amounts of pemmican without developing more than a mild acidosis. The acidosis became pronounced during starvation.

Much of the work of the party remains to be done. Large numbers of specimens of blood were brought back in a frozen condition and are now being analysed in the Department of Biochemistry. The results of these analyses will provide further information concerning fat metabolism of the Eskimo and his nutritional requirements.

PHYSIOLOGY

Scientific Research at Point Barrow, Alaska

At the instigation of the United States Office of Naval Research a scientific station has been set up at Point Barrow, headquarters of the No. 4 Naval Petroleum Reserve, a large area set apart over twenty years ago and now being actively explored and proved.

In the spring of 1947 a team of physiologists began preparations for a lengthy stay at the station. The party is led by Dr. Laurence Irving of Swarthmore College and includes Dr. Per F. Scholander, Dr. Reidar Wennesland, Dr. E. T. Nielsen, Mr. Walter Flagg, Mr. R. J. Hock, and Dr. D. R. Griffin.

The personnel reached Point Barrow by air early in August at the same time as the annual supply ships of the Navy arrived to discharge cargo for the whole base. In the cargo were the instruments and equipment for the research team including water baths, respirometers, and a large amount of equipment to keep laboratories at uniform temperatures, together with zoological field collecting kits.

The program of work is to measure oxygen consumption of animals in various temperatures to describe their metabolism in relation to Arctic conditions and to compare these metabolic rates with those of temperate and tropical animals. The heat economy of overwintering species will also be observed.

An early achievement was the collection of marine animals brought in by the storms from the Arctic Sea. Eskimo assistants are being used extensively for field observation and collecting and for constructing traps and cages for fishes, birds and mammals. Blue foxes and ground squirrels have been obtained in sufficient numbers for experimentation as have also snow bunting, marine isopods, and decapods and several species of fish and fresh water crustaceaus.

Collections of plankton will be carried out through the winter and mice and lemmings, scarce at Point Barrow this year, have been obtained from Umiat in the interior. Twenty-five bears came in on the ice floes during September and were shot along twenty-five miles of coast, some by the research team thus causing enthusiasm for science among the natives.

Many field collecting trips have been made by air, land, and water including visits east along the coast to Barter Island and west as far as Wainwright. Journeys have been made up the Inaru, Meade, and Ikpikpuk rivers, and to Umiat and Chandler Lake inland, the latter at 3,000 feet in the Endicott mountains. The laboratory is one of the usual Quonset huts at the base, 20′ by 40′, heat being furnished by oil burning space heaters and circulated by small fans. Propane gas is used for burners and there is a supply of fresh and distilled water.

GEOLOGY

Geological Research Along the East Coast of Hudson Bay

Dr. E. H. Kranck of the University of Neuchatel spent the last week of July and all of August 1947 between James Bay and Port Harrison. The principal purpose of the field work was to observe the Precambrian bedrock of the coast, especially at Portland Promontory. In addition attention was given to topographic forms, post-Cambrian movements of the bedrock and to glacial and post-glacial geology. Dr. Kranck reports that the east coast of James Bay represents a typical

peneplane surface cut into a Precambrian "rockground". The coast bears a striking resemblance to that of Finland. Along both coasts there is a "skerry guard" of barren rocky islands rounded by the inland ice, and an interior coastal zone with broad shallow bays filled with alluvium. From the sea the coast skyline is almost horizontal. Farther north, the coastline follows the contact between the Archaean rocks and the late Precambrian sediments and is generally very straight. The uplift which caused the seaward slip of the Nastapoka series must, in the opinion of Dr. Kranck be of comparatively recent age—possibly Tertiary.

Glacial drift along the east coast of the Bay is rather thin and is characterized by an abundance of drumlins. Glacio-fluvial and deposits are abundant in all the big pre-glacial valleys. A well developed beach is found in the northern parts of the area at 300-309 feet.

Silliman's Fossil Mount, Baffin Island

During the month of August, 1947, A. K. Miller and Walter Youngquist travelled by air (and for a short distance by boat) to the head of Frobisher Bay in southeastern Baffin Island.

Camp was made near the mouth of the Jordan River at the base of Silliman's Fossil Mount. With the aid of an Eskimo, a considerable variety of well-preserved marine invertebrate fossils were collected. These included corals, bryozoans, brachiopods, pelecypods, gastropods,trilobites, ostracods, and particularly cephalopods. A detailed study of the collection is being prepared for publication. It confirms the Upper Ordovician age of the containing strata and indicates that they may be correlated with the Cape Calhoun beds of northern Greenland, the Red River formation of southern Manitoba, the Bighorn formation of Wyoming, and probably the Whitewater formation of Ohio and Indiana

An hitherto unknown limestone outlier was discovered just west of the Jordan River and some 13 miles above its mouth. It is considerably larger than Silliman's Fossil Mount and is divided into two unequal parts by a tributary of the Jordan. The larger is several miles in length.

Geological Reconnaissance of Canadian Arctic Islands

Dr. Y. O. Fortier of the Geological Survey of Canada accompanied a party of the Dominion Observatory Magnetic Survey to Victoria, Prince of Wales, King William and Somerset Islands and to Boothia Peninsula during July and August 1947. On flights aggregating several thousands of miles he was able to observe bedrock geology, topographic forms, Pleistocene glaciation, present ice conditions and evidence of land emergence. Horizontal beds, apparently mainly of limestone were observed along the east coast of Victoria Island and a collection of fossils made at Greely Haven may establish the age of strata at what is now a blank area on the geological map. Contact zones between Precambrian and Palaeozoic rocks were observed near the west coast of Boothia Peninsula and at Fort Ross on Somerset Island.

The Arctic islands visited by Dr. Fortier display three types of topography; (1) low, poorly drained area displaying a multitude of lakes; (2) well-drained areas with many rivers, some of them deeply incised, and with few or no lakes. The land rises to perhaps 800 feet above sea level, some of the higher parts forming tablelands underlain by horizontal strata; and (3) rocky, rugged plateau

areas, especially well-dissected near the coast, with large tracts with few or no lakes and underlain by Precambrian rocks.

Boulder till, erratics, local striae and drumlinoids everywhere suggest that the Arctic islands visited were over-run by glaciers. Indications of the recent emergence of the islands from the sea are afforded by raised beaches and the presence of marine shells as much as 415 feet above sea level on the north coast of Prince of Wales Island.

Newfoundland-Dalhousie Labrador Expeditions 1946, 1947

Professor G. Vibert Douglas of the Department of Geology, Dalhousie University, Halifax, Nova Scotia, was leader of expeditions to Labrador in 1946 and 1947. The work was carried on under the auspices of the Newfoundland Commission of Government through C. K. Howse, Geologist. Personnel was recruited from Dalhousie University.

The 1946 field season opened with departure of the expeditions 50-ton auxiliary schooner from Halifax at the end of May. Purpose of the journey was to reconnoitre the whole coast of Labrador from Blanc Sablon on the Strait of Belle Isle to Cape Chidley. Calls were made at 31 points. At seven of them, detailed mapping was carried out, employing plane tables and transits. At the remaining twenty-four places less accurate methods of survey were employed. Results of the summer's work are reported in a bulletin of the Geological Survey of Newfoundland, now in the press.

The major topographical and geological features of the coast were determined, and five distinct mountain areas were shown to be present. From north to south they are: The Torngats, Kaumajets, Kiglapaits, Benedicts, and Mealys. The geological sequence for the coastal areas was determined, and the stratigraphical column of the Ramah Series was accurately measured. The pyritic deposits at Rowsell Harbour were mapped in detail. The report contains a section on the meteorology of the Coast by G. C. Milligan. Areas were selected for further detailed study, and some of this was complete during the following season.

During 1947, G. C. Milligan mapped instrumentally the area between Rowsell and Ramah. C. H. Smith mapped a strip about 15 miles wide from Tessijualik (incorrectly spelled Tuchialik on the 8-mile maps) to the south side of Kaipokok Bay. A further area was mapped along both sides of the Canairiktok river for a distance of 35 miles inland from the bay mouth.

Greenland Coal

Professor A. Rosenkrantz was leader of a geological field party to Svartenhoek Peninsula and Disko Island in northwest Greenland during 1947. The party which was one of several sent to the Colony by the Danish government, reported the discovery of new occurences of coal and of natural gas. The newly found coal lies a few kilometres inland and would require transport to the coast before being shipped to settlements farther south.

SURVEYING

Geodetic Surveys in Northern Canada

During the 1947 season the Geodetic Service of Canada, Department of Mines and Resources, had six astronomic observing parties working in Mackenzie

District, N.W.T. These parties engaged in locating control points for aerial photographic mapping, worked in close co-operation with the Royal Canadian Air Force whose photo-survey squadrons provided two Canso amphibian and four Norseman aircraft to transport supplies, equipment and personnel.

Operations were carried on in the 105,000 square miles of Northern Canada located between the mouth of the Mackenzie River, Cambridge Bay and Great Bear Lake. Ice conditions in July, accidents to aircraft, and continuous bad weather in August prevented more than a quarter coverage of this area with twenty-two observation points. Lakes were not entirely free of ice until July 30th and freezing temperatures with snow storms hampered flying from August 15th to the end of the month when field operations terminated. Eighteen astronomic control points were also established in the James Bay and southern Hudson Bay area. Eight of these points were fixed by a canoe party which left Moosonee on May 28, but, owing to the late break-up did not reach Albany until June 17. Akimiski Island was circumnavigated on the way north, and York Factory reached on August 29. The party was flown out from there by R.C.A.F. Canso. A second party established points at Rupert's House, Charlton, Weston, North Twin, Walter, Grey Goose, Bare and Bear islands, and two points inland west of Moosonee. They worked from a chartered Roman Catholic mission boat until it was wrecked on Grey Goose Island. Transportation for the remainder of the summer was provided by Austen Airways. The control stations were photographed by R.C.A.F. planes flying from Churchill, Kapuskasing and Ottawa. Both parties made observations on the fauna and ecology. Seven hundred and fifty birds were collected for the National Museum.

FROZEN GROUND

Permafrost at Norman Wells, N.W.T.

A permafrost investigation by R. A. Hemstock is being carried on at Norman Wells in conjunction with general construction program of the Imperial Oil Company. It has been found that temperatures are the most important single factor in the formulation of adequate designs for the permafrost region. Complete air temperature records have been kept over the past four years, and other temperature readings were begun in 1947. Among these other records are air temperatures taken under the plant boiler house. The effect of a temperature rise beneath the floor on frost level will be determined.

During the 1947 summer the construction program required the driving of 780 piles. As these piles were driven, thermometer wells were located along the full length of several piles. Temperature records are being kept to show the rate of back-freezing, and the final temperatures reached along the length of the pile. Although all piles used are steel, some wooden piles were driven to give comparisons in the above work. The results indicate that metal piles freeze in very quickly—and may therefore be loaded almost immediately after driving.

At present tests are being carried out at several of the abandoned oil wells in the vicinity to determine the depth of permafrost. This will include tests near the Mackenzie River and also at some distance from it. Results, so far, indicate permafrost to a depth of 140′ at Norman Wells. Temperatures have also been taken at intervals over this depth.